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FINAL
(see attached explanation on dates)

FINAL REPORT

Subject Area: Marketability of the Peanut—Seed Quality

Title: Spotted Impact of Environmental Factors on Seed Quality of Selected Peanut Cultivars.

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Problem and Need: The northwest Texas peanut growing region experiences generally cooler temperatures than do other U.S. growing areas, although rivaled by Oklahoma and the Virginia-North Carolina region. Our unusual temperatures are a result of both altitude and latitude. Elevation for the region ranges from 2,000 to 4,000 feet with latitude ranging from 32°45' to just over 34°. In comparison, the elevation at Pearsall in the South Texas peanut growing region is 650 feet at 25° latitude. Heat unit accumulation averaged over several years during the May 15 to October 15 growing season is 3,200 in western Gaines County, compared to 4,500 or more in South Texas. There are both advantages and disadvantages to our cooler climate. We tend to focus on disadvantages, because the vast majority of U.S. peanuts are grown under markedly warmer conditions. Cooler temperatures in the spring slow germination, emergence, and early season growth. Cooler temperatures in the fall may slow maturation or cause freeze damage in the worst case. Cool temperatures are an advantage when they prevent the development of aflatoxin, when they reduce dark respiration that uses up carbohydrates fixed during the daytime hours, or when they slow the progression through phenological stages allowing time for accumulation of nutrients to be deposited in the peanut seed. Despite our overall cooler climate, the region can experience extremely hot daytime temperatures during some growing seasons. In 2003, the combination of immaturity and high temperatures at harvest time caused off-flavors in a substantial quantity of West Texas peanuts.

Researchers have rightfully focused a lot of attention on peanut quality as related to flavor and utilization in food and snack products. Manufacture of food products represents the main final use of peanuts. Seed quality as related to germination, emergence, and seedling vigor is also important to growers in stand establishment and in having demand for peanut seed as a commodity. From the standpoint of the seed industry, they must locate seed fields where production of high quality seed is most reliable.

The cold temperatures experienced in early May of 2004 in West Texas caused delayed stand establishment in some fields. Anecdotal evidence led to the generalization that this was a problem unique to high oleic cultivars. In our experimental plots, we found that FlavorRunner 458 and Tamrun OL02 were particularly delayed, but eventually established acceptable stands. Although these two are high oleic varieties, not all high oleic varieties emerged more slowly than low oleic varieties. Andru II, GP1, and Tamrun OL01 (all high oleic varieties) emerged just as quickly as Tamrun 96 and Florunner (conventional oleic varieties). Perhaps the 2003 environmental background of the specific seed source was more important than oleic/linoleic acid (O/L) ratio.

We have observed regional effects on fatty acid profiles of seed storage fat that were probably related to temperature during seed development. When average O/L ratios for nine germplasm lines were compared, we found that the Brazos County O/L ratios were 90% and Gaines County O/L ratios were 68% of those from Frio County-grown peanuts. We have also observed differences in germination at cold temperatures that were related to storage fat chemistry. High oleic peanut breeding lines germinated more slowly under cool temperatures than did those of middle or low O/L ratios. Discrepancies from the trend of less germination-cold-tolerance as O/L ratios increased from low to high were related to the ratio of unsaturated/saturated fatty acids. In limited initial experiments, it appeared that seeds produced in South Texas may have germinated and emerged more quickly than those produced in West Texas, even though the O/L ratios were higher in the South Texas samples.

Peanut seed vigor relationships Dr. Darold Ketring, USDA-ARS, Stillwater, OK (retired) used germination data and radical length measurements at 72 hours after imbibition as a vigor index. Some commercial peanut seed companies use cool-temperature germination tests as a means of rating seed quality. A seed vigor index in cottonseed uses a combination of germination data at both high and low temperatures. Texas Department of Agriculture uses high and low temperature germination percentages to rate peanut seed quality.

Plan of action: Seed from peanut lines and varieties selected for a range of fatty acid will be compared for germination, emergence, and early plant growth under controlled temperature conditions. Seed tested will be selected from various peanut-growing regions to include geographic/environmental variation. We will employ a range of temperatures from 14 to 30 C (57 to 86 F) in initial experiments. We will pair growth chamber observations with field observations at approximately two week planting intervals beginning in early April to mid June. Fatty acid profiles will be determined for all seed. We will collaborate with peanut breeders to select additional relevant peanut lines for testing. Whenever possible, we will include some seed of the same genotype, in which variability in fatty acid profiles were induced by the location of seed production field. We will collect temperature data in a variety of experiments to search for temperature impacts. Wherever possible, we will collaborate with scientists working with flavor attributes to relate flavor and seed quality factors.

Results:

Seedling Emergence WPGRF 2004: At 14 days after planting (DAP) in the irrigation tests, Tamrun 96 had a plant population of 28,700 plants per acre (PPA), FlavorRunner458 had 7,200 PPA, and Tamrun OL02 had 18,200. Final stand counts for FlavorRunner458 was 49,700 (3.4 plants per row foot [PPRF]) and for Tamrun OL02 was 37,600 PPA (2.6 PPRF). (Table 1.)

In small plot variety trials at 14 DAP, Andru II had stands of 28,000 PPA; Florunner 40,400; FlavorRunner458 12,200; GP1 41,000; Tamrun OL01 44,400; Tamrun OL02 21,000; Tamrun 96 23,000; Olin 42,900; and Tamspan 90 35,900. Final stands were reached by 27 DAP for all cultivars: Andru II 52,100 PPA (3.6 PPRF); Florunner 54,400 (3.7 PPRF); FlavorRunner458 40,600 PPA (2.8 PPRF); GP1 55,600 PPA (3.8 PPRF); Tamrun OL01 56,500 PPA (3.9 PPRF); Tamrun OL02 37,300 PPA (2.6 PPRF); Tamrun 96 43,500 PPA (3.0 PPRF); Olin 53,900 PPA (3.7 PPRF); and Tamspan 90 50,300 PPA (3.5 PPRF). (Table 2.)

Irrigation Experiments WPGRF 2004: Despite the poorer stands in Tamrun OL02, compared to FlavorRunner458, their yields were equal, but less than Tamrun 96 when compared across all

irrigation regimes. (Table 1.) With LEPA at 100% ET replacement and at LEPA 75, yields of all varieties were equal. With Wobblers at 75 ET, FlavorRunner458 outyielded Tamrun OL02 and Tamrun 96 whose yields were equal. With the combination LEPA-Spray at 75 ET, Tamrun 96 outyielded Tamrun OL02 and FlavorRunner458 whose yields were equal. With Spray at 75 ET, Tamrun 96 and FlavorRunner458 had equal yields that exceeded those of Tamrun OL02. With LEPA 50, Tamrun 96 outyielded Tamrun OL02, which in turn outyielded FlavorRunner458.

Table 1. Stand Counts For 2004 Western Peanut Growers Research Farm Irrigation Trials

Cultivar	O/L	Seed Origin	14 DAP (PPA)	Final Stand (PPA)	Final Stand (PPRF)	Spray Yields	LEPA Yields
Tamrun OL02	High	West Texas	18,200	37,600	2.6	3,483 b*	4,247 a*
FlavorRunner458	High	West Texas	7,200	49,700	3.4	3,856 a	4,113 a
Tamrun 96	Low	Unknown	28,700	54,700	3.8	3,994 a	4,103 a

* Yields in each column followed by the same letter are not statistically different at P=5%.

Table 2. Stand Counts for 2004 Western Peanut Growers Research Farm Irrigation/Variety Trial

Cultivar	O/L	Seed Origin	14 DAP (PPA)	Final Stand (PPA)	Final Stand (PPRF)	Spray Yields	LEPA Yields
Tamrun OL02	High	West Texas	21,000	37,300	2.6	4,542 ab*	4,372 ab*
FlavorRunner458	High	West Texas	12,200	40,600	2.8	4,382 ab	4,252 ab
Tamrun 96	Low	Unknown	23,000	43,500	3.0	4,472 ab	5,102 a
Andru II	High	Southeast	28,000	52,100	3.6	4,041 b	3,621 b
Florunner	Low	West Texas	40,400	54,400	3.7	4,642 ab	4,432 ab
GP1	High	Southeast	41,000	55,600	3.8	4,832 a	4,262 ab
Tamrun OL01	High	South Texas	44,400	56,500	3.9	4,452 ab	4,822 a
OLin	High	Unknown	42,900	53,900	3.7	4,051 A**	4,021 A**
Tamspan 90	Low	Unknown	35,900	50,300	3.5	3,741 B	3,021 A

* Runner yields in each column followed by the same letter are not statistically different at P=5%.
** Spanish yields in each column followed by the same letter are not statistically different at P=5%.

So, despite strong concerns about crop stands in FlavorRunner458 and especially Tamrun OL02, other factors overshadowed the effects of plant stand and speed of emergence as measured by crop yield. In small plot variety/irrigation trials again there were little relationship between stand at 14 DAP or final stand and peanut yield. (Table 2.)

Comparative Maturity of Peanuts from 2003 and 2004 Crop Years: To illustrate the difference in maturity levels in the 2003 and 2004, we compared the hull-scrape results for both crop years. We considered the Black % + Brown % to be the percent mature pods. See Tables 3 and 4 for comparisons of maturity levels for the two crop years and differences between them.

Table 3. Hull Scrape Maturity for 2003 & 2004 Western Peanut Growers Research Farm Irrigation Trials—Spray Treatment

Cultivar	O/L	Black + Brown % 2003 Crop Year	Black + Brown % 2004 Crop Year	Maturity Difference 2004 - 2003
Tamrun OL02	High	15	59	44*
FlavorRunner458	High	17	46	29
Tamrun 96	Low	13	50	37

* Tamrun OL02 was only in the test in 2004, replacing Florunner from 2003.

Table 4. Hull Scrape Maturity for 2003 & 2004 Western Peanut Growers Research Farm Variety/Irrigation Trials—Spray Treatment

Cultivar	O/L	Black + Brown % 2003 Crop Year	Black + Brown % 2004 Crop Year	Maturity Difference 2004 - 2003
Tamrun OL02	High	22	52	30
FlavorRunner458	High	17	67	50
Tamrun 96	Low	14	61	47
Andru II	High	23	69	46
Florunner	Low	24	68	44
Tamrun OL01	High	29	81	52
OLin	High	39	88	49*
Tamspan 90	Low	55	94	39

* Olin in 2004, Unknown low oleic Spanish in 2003.

Because of the immaturity in 2003 and the high temperatures at harvest, we found high levels of off-flavors (fruity-fermented) in many of the entries, but essentially no off-flavors in the 2004 kernels.

Measuring Seed Quality: We employed two different tests for seed vigor: (1) Cold Temperature Germination and (2) Seed Vigor Index. Cold temperature germination tests are used by Texas Department of Agriculture on cottonseed and peanut seed to estimate seed vigor. In the cold temperature germination peanut tests, runner peanuts are subjected to 18 C (64.4 F) for 15 days and the percent germinated determined (1.25" [31 mm] radical length is considered germinated). Spanish peanut seed are evaluated similarly, except that germination percent is calculated after 10 days at the cold germination temperature.

In the peanut seed vigor index (SVI) developed by Dr. Darold Ketring, USDA-ARS, Stillwater, OK (retired), peanut seed are heated for nine hours at 60 C (140 F), then germinated for 72 hrs at 29 C (84 F). The percent germination is calculated (2 mm radical length is considered germinated) and radical lengths are measured. Length coefficient values are assigned—3 if radical is 2-5 mm, 8 if 5-10, 15 if 10-20, 25 if 20-30 mm, and 31 if >30 mm. The number of each seed with radicals in each length range is multiplied by its length coefficient value; the resulting numbers are added together; and the sum multiplied by the percent germination to obtain the SVI value.

When we compared the field stands at 14 DAP and final stands with the two seed quality measures (Table 5) by regression, we found that the R-Square values were 0.544 for 14 DAP Stand vs. Cold Germination %; 0.677 for 14 DAP Stand vs. SVI; 0.530 for Final Stand vs. Cold Germination %; and 0.654 for Final Stand vs. SVI. Therefore, we concluded that for these experiments, the seed vigor index was more accurate than Cold Germination % in predicting field stands. Although the radical length measurements are somewhat tedious, SVI in quicker requiring only a 9-hour heat treatment and 72-hour incubation compared with 10 to 15 day incubation for the Cold Germination % test.

Table 5. Seed Vigor Index and Cold Germination Data for seed planted in 2004 Western Peanut Growers Research Farm Irrigation/Variety Trial.

Cultivar	O/L	Seed Origin	14 DAP (PPA)	Final Stand (PPA)	Final Stand (PPRF)	Seed Vigor Index	Cold Germ. Test
Tamrun OL02	High	West Texas	21,000	37,300	2.6	488	69 %
FlavorRunner458	High	West Texas	12,200	40,600	2.8	106	56 %
Tamrun 96	Low	Unknown	23,000	43,500	3.0	947	81 %
Andru II	High	Southeast	28,000	52,100	3.6	1,529	84 %
Florunner	Low	West Texas	40,400	54,400	3.7	2,266	97 %
GP1	High	Southeast	41,000	55,600	3.8	2,108	98 %
Tamrun OL01	High	South Texas	44,400	56,500	3.9	2,281	*
OLin	High	Unknown	42,900	53,900	3.7	2,282	96%
Tamspan 90	Low	Unknown	35,900	50,300	3.5	221	60 %

* Insufficient seed to run test.

Dates Explanation #140 2005

-----Original Message-----
From: Mike Schubert [mailto:mschuber@ag.tamu.edu]
Sent: Monday, November 13, 2006 9:29 AM
To: shelly@texaspeanutboard.com
Subject: RE: I lost your report

Shelly,

This is the report on the work that we proposed in September 2004. The work was on seed lots planted in the spring of May 2004 produced under the adverse harvest conditons in 2003.

We have done a few things with seed produced in 2004 and planted in 2005, but this was after the remainder of the NPB money was returned to you. I have not worked up all the data from those experiments that I did
primarily in the first half of 2006 with non-NPB funds and funds generated by royalties from OLin, Tamrun OL01, and Tamrun OL02 using my personal labor.

It was my original intent to request funding for two additional years, but decided that other aspects of my work in my retired, half-time status needed attention. I did not, therefore, request any NPB funds in September 2005 or 2006, although I am a collaborator on one of Mark Burow's proposal that was just made.

So, this the report for the work done with the last funding that I received from NPB.

Let me know if that doesn't clear up their confusion.

Mike

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>>> "Shelly" <shelly@texaspeanutboard.com> 11/10/06 3:31 PM >>>
Mike, I sent the one you attached, to NPB and they said that it was an '04 report... I didn't even look at it good, I just forwarded it on... Anyways, I hate to ask this but can you find a 2005 final report? NPB is withholding 10% till I can get them the report... Thanks so much.

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